

Laser Exposure to Aircraft

CAPT Matt Rings
Aerospace Ophthalmology

Disclosure

Statement
CAPRI Kings has investments in the following companies who manufacture military laser systems:

- General Dynamics
- Northrup Grumman Corp
- Coherent Inc.
- II-VI inc.

Laser Threats

- Handheld Laser Pointers (Red/Green/Blue)



- CAS lasers (vis/IR)



- Airborne lasers – targeting and countermeasures (vis/IR)



- Anti-personnel lasers (Green)





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3D

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In stock

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1W+ (\$299.95)



Expanded Lens Kit:

Choose an Expanded Lens Kit:



LaserSaber:

Add a LaserSaber:



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Worldwide
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CNN

"The perfect gift for the supervillain"

WALL STREET JOURNAL

"A seriously baddass laser device"

WIRED

The most powerful handheld laser in the known universe.

The Arctic is a Class 4 laser that puts out up to 1,250 milliwatts of power - strong enough to burn holes, pop balloons, and start fires from across the room. The Arctic's beam is so bright that it can be seen from outer space and extends so far that you can literally point out individual stars in the sky.

This laser is built to endure. Its chassis is crafted from aircraft-grade aluminum, making it virtually indestructible, and the Arctic boasts a sleek design (which may seem a bit familiar; George Lucas once sued us over it) that makes it an unmitigated thrill to wield.

The Arctic is simply the most advanced and powerful handheld laser in the known universe - and it's available to you.

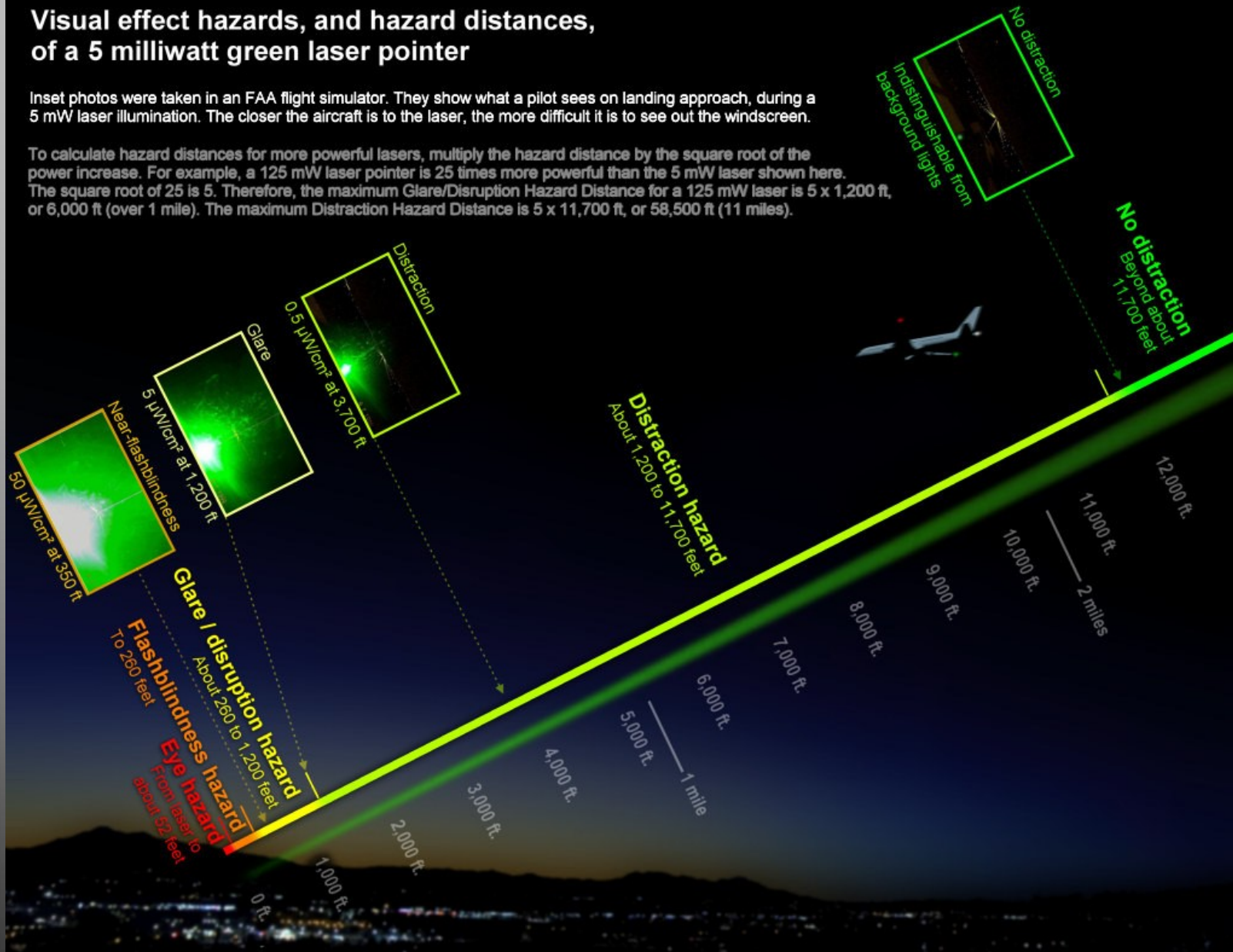
Laser Dazzle



Visual effect hazards, and hazard distances, of a 5 milliwatt green laser pointer

Inset photos were taken in an FAA flight simulator. They show what a pilot sees on landing approach, during a 5 mW laser illumination. The closer the aircraft is to the laser, the more difficult it is to see out the windscreen.

To calculate hazard distances for more powerful lasers, multiply the hazard distance by the square root of the power increase. For example, a 125 mW laser pointer is 25 times more powerful than the 5 mW laser shown here. The square root of 25 is 5. Therefore, the maximum Glare/Disruption Hazard Distance for a 125 mW laser is $5 \times 1,200$ ft, or 6,000 ft (over 1 mile). The maximum Distraction Hazard Distance is $5 \times 11,700$ ft, or 58,500 ft (11 miles).



Tahrir Square - Egypt



Laser Physical Effects

- Glare “Dazzle”
- Flash-blindness
- Irritation
- Photophobia
- Headache & eye pain
- Sub-clinical tissue damage
- Visible retina and ocular damage
- Retinal hemorrhage



Laser Aviation Effects

- Surprise / Startle effect
- Distraction
- Inability to discern instruments and landing lights
- Mission compromise or failure
- Loss of aviator temporarily or permanently to flight



THE GREEN FLASH

BY LTJG. DAN ARSENAULT

After a training mission in the warning areas off the coast of Jacksonville, Fla., our P-3C entered the GCA pattern at NAS Jax for night field work and pilot-proficiency training. We flew three precision approaches to runway 28 and requested the next one be a full-stop to conclude our evening of training. With the pilot at the controls in the right seat, and while beginning our turn upwind in the GCA pattern, a steady green light crawled up the nose radome. Green rays momentarily illuminated the flight station.

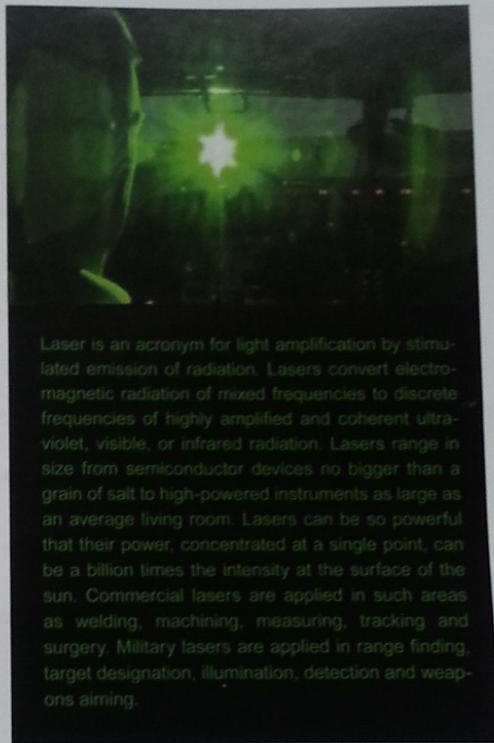
The pilots, flight engineer, and other crewmembers in the flight station realized that the green light was a laser. Before our return home from a recent deployment, we had read about several such incidents in the Jacksonville area, but none of us had ever experienced one. We reported the incident to radar control and tower and landed. After shutting down, we began the process of reporting the incident and letting others know what had happened.

Almost 20 lasing incidents were reported Navy-wide via hazreps in the last year (eight instances were in the NAS Jax GCA box). In the P-3 community, hazreps have been generated in all areas of operation, including recent lasings in Kuwait and Kadena.

Will lasers damage your eyes? Absolutely. The initial effects can be glare, after-images, pain or discomfort, and temporary blindness. Long-term damage can range from mild and reversible to permanent. Injuries include burns on the cornea or retina, holes, hemorrhages, retinal scarring, macular holes and macular cysts.


If you find yourself in a situation like ours, look away. Do not stare at the laser. Avoid rubbing your eyes as this may irritate any damage caused by the initial contact. Immediately mark your position and report the incident to ATC, making note of the lat-long for further reporting after you land.

As soon as possible after landing, per OpNavInst 5100.27B, consult an ophthalmologist or optometrist, even if you just suspect laser exposure. Early medical intervention may lessen the severity of the damage or subsequent retinal scarring. Get in touch with your aviation safety officer, fill out an ASAP report to the



Laser is an acronym for light amplification by stimulated emission of radiation. Lasers convert electromagnetic radiation of mixed frequencies to discrete frequencies of highly amplified and coherent ultraviolet, visible, or infrared radiation. Lasers range in size from semiconductor devices no bigger than a grain of salt to high-powered instruments as large as an average living room. Lasers can be so powerful that their power, concentrated at a single point, can be a billion times the intensity at the surface of the sun. Commercial lasers are applied in such areas as welding, machining, measuring, tracking and surgery. Military lasers are applied in range finding, target designation, illumination, detection and weapons aiming.

Federal Aviation Administration, and complete a hazrep. Expedient reporting can assist local law enforcement in determining the location of the lasing source.

Lasing activity can be considered "interfering with flight crew" and is punishable under the Patriot Act, carrying fines in excess of \$500,000 and 20 years in jail. FAA laser reporting procedures can be found at <http://www.faa.gov/aircraft/safety/report/laserinfo/>. 

LTJG. ARSENAULT FLIES WITH VP-45.

www.faa.gov/mobile/?event=laser

Approach

Laser 'epidemic' hamstrings CG's air-rescue mission, pilots

By Jacqueline Klimas
jklimas@militarytimes.com

Could you swim four miles to shore in open water?

Two boaters stranded at sea July 26 had to when the Coast Guard Air Station Savannah, Ga., helicopter sent to rescue them returned to shore after being hit by a green laser beam.

"They were really lucky," said Cmdr. Gregory Fuller, commanding officer of Air Station Savannah. "Had they not been good swimmers, it would've been two fatalities."

The problem of lasering has reached "epidemic" proportions this year, Fuller said. Tourists buy green laser pointers for a couple of dollars at beachside stores in places like Savannah or Atlantic City, N.J. — homes to two air stations that have seen a recent spike in incidents. Once night falls, people shine the lasers at aircraft. The beam can bounce around the cock-

pit, disrupting the aircrew's night vision, and can cause permanent damage if it hits a crew member directly in the eye.

The problem is so severe at Air Station Savannah that the area has been deemed "high risk," and all decisions to enter that air space must be cleared through either Fuller or the sector commander at Air Station Charleston.

"It's gotten to where I pretty much have a 100 percent chance of my crew getting lasered if I send them to this area," Fuller said.

Fuller must look at alternatives to established air-rescue techniques — using a surface asset, when possible, and keeping the aircraft farther offshore until daylight, when the lasers will no longer pose a threat.

These methods aren't foolproof. Lt. Alex Drake, a pilot from Air Station Savannah, was flying a search-and-rescue pattern looking

for a boater in distress when he was hit by several lasers, despite being three miles offshore.

He only got an indirect hit, meaning the cockpit illuminated, but Drake's flight mechanic got hit directly in the eye.

"We got parallel to the beach heading the opposite direction," Drake said of when he was hit.

He flew farther from the beach and the beam. It didn't help.

"We were about five miles from the beach at that time, and they were still hitting us, so we departed the area," he said.

Laser guidance

There is no servicewide policy on what an aircrew should do if it gets lasered, Senior Chief Public Affairs Specialist Mike Hvozda said.

"We want the units to come up with their best practices we can use to make the Coast Guard policy," he said.

Fuller's pilots at Air Station Savannah are directed to land as soon as possible and be cleared by a flight surgeon if hit indirectly. In the case of a direct hit, the crew member must see an optometrist before flying, which could keep them grounded for up to 24 hours.

At Air Station Atlantic City, the station with the most incidents, the rules are a bit less strict. The crew is grounded and evaluated by medical personnel if hit directly, but if there's an indirect hit, pilots are instructed to "avoid it and head out of the area," according to Lt. Neil Corbin, a pilot at the air station.

Corbin said it is the crew's responsibility to seek medical attention if they feel they have had direct exposure.

The Federal Aviation Administration has more relaxed standards. According to an FAA spokeswoman, if the pilot lands and does not want medical attention, the issue is dropped. If the pilot is injured, the pilot must tell the flight surgeon — and his doctor at the next flight physical.

The Navy and Air Force both leave the decision to land or seek care up to the aircrew, according to representatives from each service.

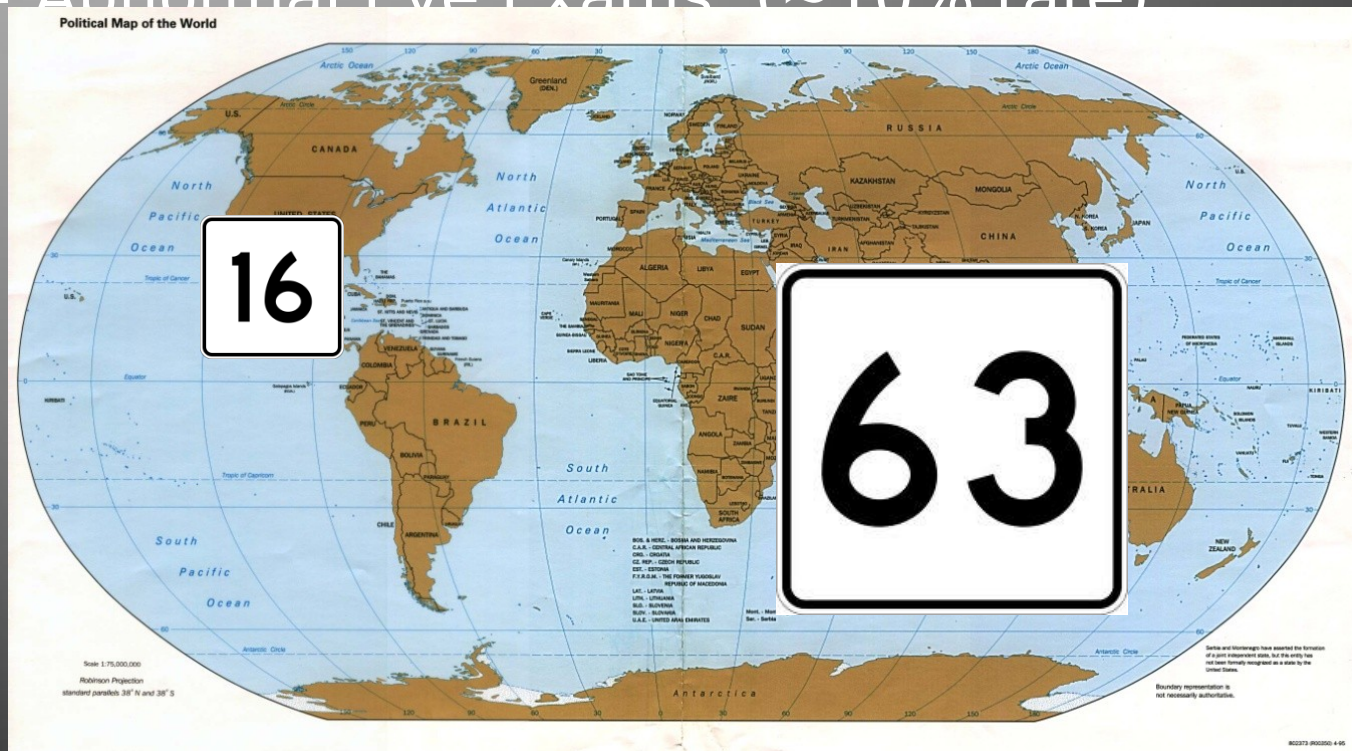
Ground Incidences

- “Friendly fire” from ground targeting lasers:
- “**Since** November 2008, [we have] had 64 laser incidents reported in Iraq, resulting in 45 documented injuries to soldiers. Two of those injuries were permanent — one soldier is now legally blind in one eye, Hayes said.”
- “**Usually**, the damage is temporary,” he said, “but they have to be evaluated by a laser specialist in the States.”
- (*Stars & Stripes*, June 14, 2009)



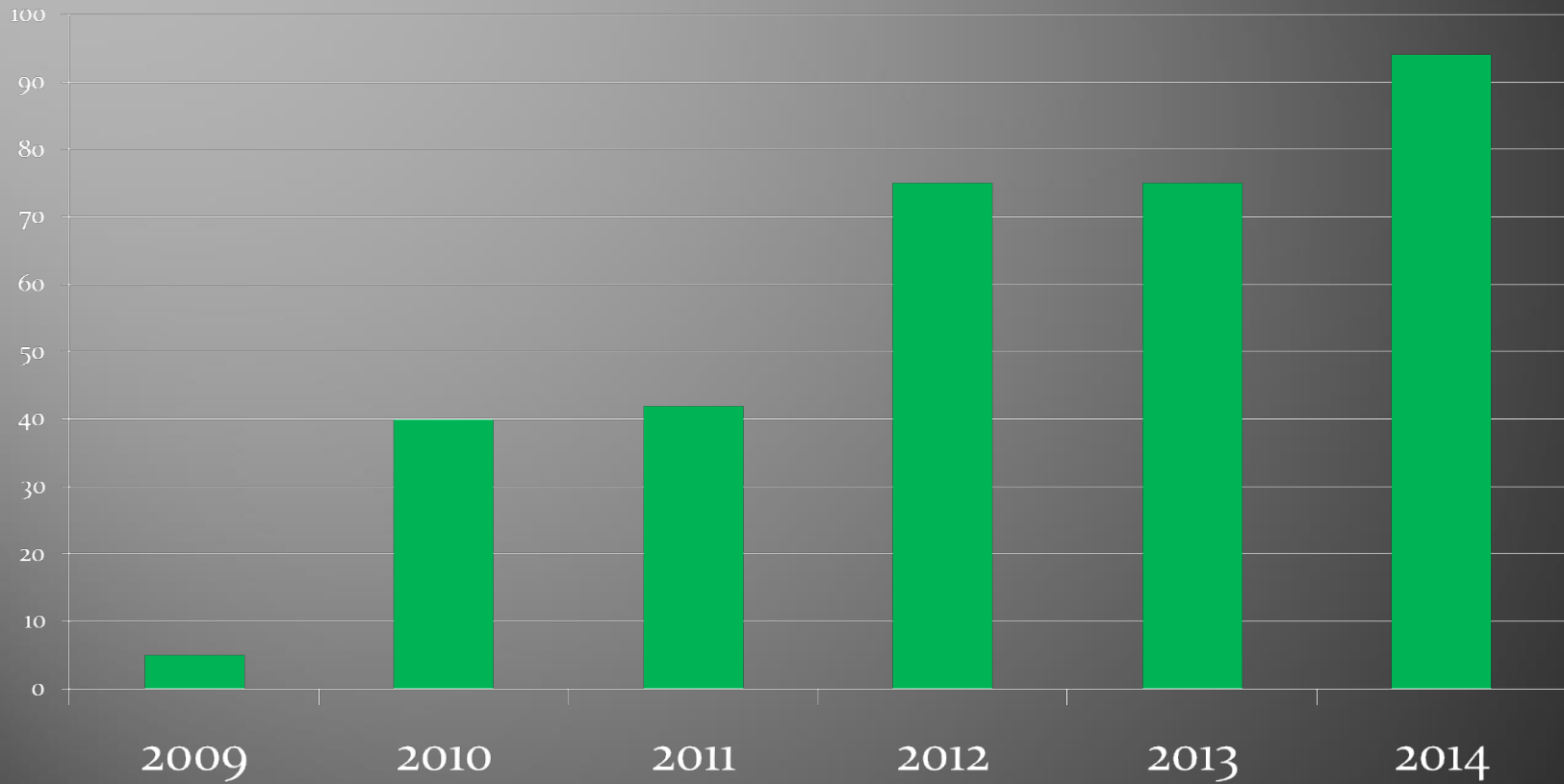
2012 DoD Aviation Incidences

- 2012
 - 79 Aviation Laser Incidents *reported via Hotline*
 - 20 HAZREPS
 - Abnormal Eye Exams (~10% rate)



USN AVIATION

Laser Incidences



Note: Multiple persons per incident is frequent

Commercial / Civil Aircraft

- 2004: 46 incidences
- 2008: 988 incidences
- 11% reported distraction, glare, afterimage, ops interference,
- 2% pain/injury
- 69% on final approach
- 92% green lasers, 5% red lasers
- 7PM to 11PM (70%)

*The Illumination of Aircraft at Altitude by Laser Beams: A 5-Year Study Period (2004-2008 -
FAA*

Pre-Flight Crew Procedures

- OPNAV 3710 : annual LEP / laser training
- Review reports of any laser activity in the area reported to ATC (concerts, pireps, intel)
- Consider Laser Eye Protection (LEP) based on theater threat intelligence
- Discuss in-flight laser exposure procedures
- Carry small Amsler grid (if significant threat)
- LEP must be worn if “significant laser threat” exists (per OPNAV 3710.7U)

In-Air Exposure Procedures

- Look Away & shield eyes (don LEP if available)
- DO NOT rub the eyes – increases irritation
- Turn up instrument lights
- Mark the position, time, and report to ATC
- Unexposed co-pilot gets on instruments
- Query other crew members for exposure
- Self-examination using small print or Amsler grid (if available)
- 'Self-triage' vision
 - able to read small print,
 - check individual eyes,
 - check pocket Amsler grid, nav charts, HUD or MFD for any visual defects
- Determine mission viability, if significant vision symptoms prevent safe continuance

Crew After-Landing Procedures

- Notify Chain of Command
- Notify Flight Surgeon & Laser Safety System Officer (per OPNAVINST 5100.27B)
- Undergo eye exam by Flight Surgeon as soon as practicable
- Complete HAZREP
- Complete FAA laser exposure web report
<http://www.faa.gov/aircraft/safety/report/laserinfo/>
- Call DoD Laser Hotline (24/7)
Toll-free: **800-473-3549**



View Incident Details

[Incident Search](#)

Details Files (0)

Incident ID: 87

[Edit this Incident](#) | [Export to PDF](#)

Created:

Modified:

Laser Accident / Incident Information

Location of Accident:	4.5 miles east of Chambers Field (KNGU). N 36 56 15 W 076 12 54		
Name/Description of Laser:	Green Laser		
CONUS/OCONUS:	CONUS	Country:	USA
Exposure Distance:	304.80 meter(s)	Exposure Duration:	3 second(s)
Incident Date:	Jan 20	Incident Time:	1815
Wavelength:	Green	Type of Exposure:	Intrabeam
Was Laser Eye Protection Worn?:	No	Type of Eye Protection:	
Were Optical Instruments Used?:	No	Flash Blindness/Duration:	

Description of Accident/Incident

We had an unauthorized lasing event, 6 Jan 2015, 1815L, 4.5 miles east of Chambers while on a GCA final approach to rwy 28. Approximate lat/long is N 36 56 15 W076 12 55. It was a green laser that illuminated the port side (south side) of the aircraft. Two of our guys (one pilot, one aircrew) are going to medical 7 Jan 2015 to get an eye exam. We were on NVGs without LEP.

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Medical Findings

LCDR [redacted] had an optometry exam on 7 Jan 20 [redacted] for possible laser exposure. No abnormal findings.

Incident Comments

There are no comments posted on this incident.



Laser Incident Reporting Form

Your Details

Name of pilot/crew member reporting

First and last name

Email address

example@domain.com

Flight Details

Flight number, call sign, and aircraft registration number

e.g. SWA572, Southwest, N12345...

Aircraft Make and Model

e.g. Boeing 737, Cessna 172, Airbus A320...

Laser Incident Details

Laser light color:

Select Beam Color



Date

2013-01-16



Time (UTC/Zulu)

21:29



Location of aircraft during incident



AFRL-SA-WP-SR-2012-0005

**UNITED STATES AIR FORCE SCHOOL
OF AEROSPACE MEDICINE LASER
INJURY GUIDEBOOK**



John M. Gooch, Col, USAF, MC, CFS
Richard R. Harvey, Lt Col, USAF, MC, FS
U.S. Air Force School of Aerospace Medicine
Aerospace Medicine Consultation Division/FECO

Wanda Parham-Bruce, Lt Col, USAF, BSC
U.S. Air Force School of Aerospace Medicine
Aeromedical Research Department/FHC

Bret Z. Rogers, DAF
U.S. Air Force School of Aerospace Medicine
Occupational and Environmental Health Department/OEHI

Leon N. McLin Jr., DAF
711HPW/RHDO
4141 Petroleum Road
Ft. Sam Houston, TX 78234-2644

April 2012



APPENDIX C

Laser Incident Questionnaire

The following questions are designed to gather information to assist medical, operational, and intelligence personnel in analysis of laser beam exposure incidents. It should be anticipated that further questions and information will be sought as time allows. Finally, remember to call the Tri-Service Hotline at 1-800-473-3549 or DSN798-3764 as soon as possible.

1. Describe the light you saw

What color(s) was the light(s)?

How bright was it?

How long was it on?

Was it uniform in appearance?

Did the intensity of the light change?

Was it constant or did it pulse or flicker? If so, how fast did it pulse or flicker?

How wide (perhaps using finger widths at arm's length) was the beam at origin?

How wide on exposure was the light? Did the light fill your cockpit or compartment?

Was the light emanating directly from a source or was it reflected off a surface?

Were there any other unusual light sources?

Have you seen this light(s) before?

2. Date, location, and circumstances

- a. Date and time (local & Zulu using a 24-hour clock) that the exposure occurred.

local: DDMMYYYY hh:mm

Zulu: DDMMYYYY hh:mm

- b. Location of exposure (if nonclassified). Describe location preferably using degrees

Laser Injury Guidebook

UNITED STATES AIR FORCE SCHOOL
OF AEROSPACE MEDICINE LASER
INJURY GUIDEBOOK

- United States Air Force School of Aerospace Medicine Laser Injury Guidebook:
<http://www.dtic.mil/dtic/tr/fulltext/u2/a559312.pdf>

Appendix C: Laser Incident Questionnaire

Appendix D: Amsler grid

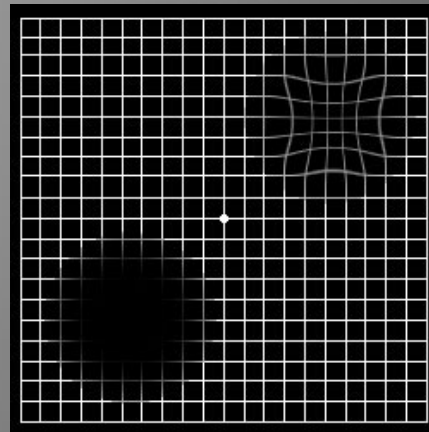
Flight Surgeon Procedures

- Complete the 'Laser Incident Questionnaire' (Appendix C of Laser Injury Guidebook)
- Obtain complete history of events
- List ocular symptoms
- Document LEP or eyewear worn (e.g. NVGs)



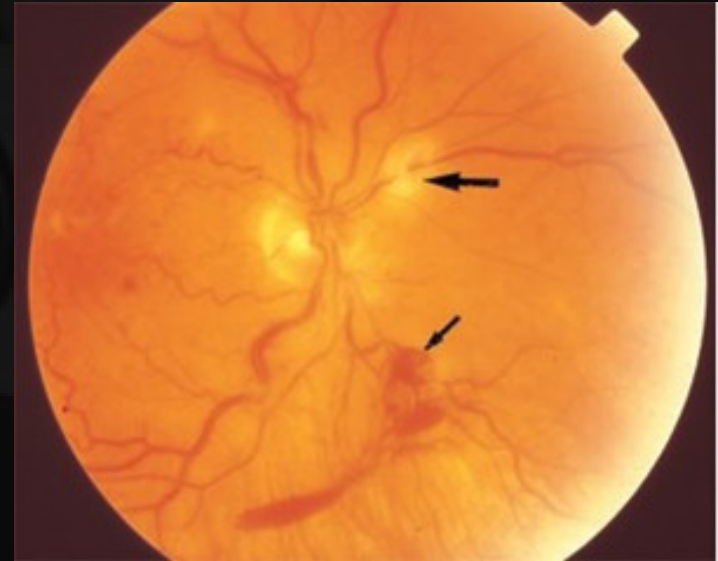
Flight Surgeon Physical Exam

- Visual Acuity (with correction)
- Amsler Grid test
- Pupil exam
- Stereopsis testing
- Color Vision
- Slit Lamp – corneal abrasions/burns, opacity, conjunctival injection.



Flight Surgeon Exam and Actions

Dilated Retinal Exam



Evaluate for retinal changes, blood, burns,
white lesions

Ophthalmology Consultation

- Does laser eye exam reveal significant visual or ocular findings? If yes, consult ASAP to ophthalmology or aerospace optometrist
- Navy/USMC: OPNAV 5100.27:
 - **ALL exposures get consult exam**
- Make recommendation on Fitness for Aviation Duty or further medical management

Laser Exposure Aerospace Pearls

- 99%+ of exposures will not cause permanent injury– may return to flight if no persistent symptoms, normal vision testing and normal exam. Document follow-up in 1-3 days.
- Actual injuries or persistent symptoms:
 - “Down” chit for flight pending further workup
 - Ophthalmology/Optometry consult (aerovac as needed)
 - Laser Hotline advice on ALL exposures

DoD Laser Injury Hotline & Info

















- HOTLINE Toll-free: **800-473-3549**
- Comm: **937-938-3764**
- USAFSAM Ophthalmology: 937-938-2675



- NAMI Ophthalmology: 850-452-2933
- Pubs (unclassified):
<http://tinyurl.com/Naval-Laser-Safety-Info>

Laser Safety in Aviation

Name	Size	Modified
 08-08-2012 - The safety of laser pointers myths and realities.pdf	98.59 KB	30 hrs ago
 6470.23 - Medical Management of Non-Ionizing Radiation (LASER).pdf	1.83 MB	30 hrs ago
 DoD Laser Injury Hotline Slides.ppt	597.5 KB	30 hrs ago
 EDU-5P Aircrew Brief Instructor Guide.doc	129.5 KB	30 hrs ago
 Incident Report Form-Blank.pdf	115 KB	30 hrs ago
 Laser Exposures in Aviation Update USNAC 2013.ppt	0.89 MB	30 hrs ago
 laser eye injuries USMC 2012.xls	19.5 KB	30 hrs ago
 Laser Eye Protection.ppt	5.6 MB	30 hrs ago
 Laser Illumination of Flight Crew Personnel 5 yr study.pdf	685.81 KB	30 hrs ago
 Laser Safety 5100 27B.pdf	740.73 KB	30 hrs ago
 Laser YouTube Videos.url	177 bytes	30 hrs ago
 Laser-Injury-Guidebook-AFRL[1].pdf	397.3 KB	30 hrs ago
 NAMI EP 06 LASERS.pptx	7.12 MB	30 hrs ago
 USAFSAM Laser Injury Guidebook- 2012.docx	246.25 KB	30 hrs ago

